Know-how for Horticulture™

Information packages and decision support software for improved nutrient management of potato crops

N Maier and K Shepherd
South Australian Research and Development Institute

Project Number: PT94028

PT94028

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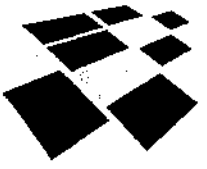
Horticultural Australia Ltd
Level 1
50 Carrington Street
Sydney NSW 2000
Telephone: (02) 8295 2300
Fax: (02) 8295 2399
E-Mail: horticulture@horticulture.com.au



Horticulture Australia

SARDI

Location
Waite Research Precinct
Hartley Grove
Urrbrae SA 5064

Correspondence
Waite Research Precinct
GPO Box 397
Adelaide SA 5001

Telephone
08-8303 9400

Facsimile
08-8303 9403

INFORMATION PACKAGES AND DECISION SUPPORT SOFTWARE FOR IMPROVED NUTRIENT MANAGEMENT OF POTATO CROPS

HRDC Final Report

September, 1998

Project PT94028

by N. A. Maier & K. L. Shepherd

SARDI

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

CONTENTS

1. SUMMARY

A research & development project funded by the **Horticultural Research and Development Corporation** (HRDC) was conducted between July 1994 to June 1998, to develop information packages and decision support software for improved nutrient management of potato (*Solanum tuberosum* L.) crops. Circumstances giving rise to our project are, i) low utilisation rates of nutrient management information or improved technology; ii) the need for improved, directly useable nutrient management technology; iii) the need for a reference manual and/or electronic reference library on the nutrient management of potato crops; iv) extension publications on potato crop nutrient management need revision or are lacking; and v) the need to integrate management strategies to reduce cadmium residues in tubers into nutrient management technology.

The **specific objectives of the project** were to, i) develop decision support software to improve the nutrient management of potato crops throughout Australia; ii) compile information on the nutrition and nutrient management of potato crops, and prepare a plant analysis and interpretation manual to facilitate adoption of this technology by technical advisers, agribusiness and growers; iii) incorporate into the information packages management options to minimise cadmium residues in potatoes; and iv) provide education and guidance for technical advisers, agribusiness and growers in the use of the new nutrient management technology to facilitate its utilisation and to disseminate information.

As part of Project PT94028 200 ***CropTest* kits** were produced. Each kit consists of, i) CropTest decision support software (CD-ROM); ii) Licence Agreement, including Terms and Conditions; iii) User's Guide; and iv) Plant Analysis & Interpretation Manual for Potato.

CropTest is a decision support and information system designed to assist growers and agribusiness identify symptoms of nutrient stress, interpret plant test data and access information on plant analysis for potato crops.

Researchers and industry collaborators from around Australia contributed to the development of the **CropTest** software and the **Plant Analysis & Interpretation Manual for Potato.**

Main features include:

- Provides keys to identify symptoms of nutrient stress.
- Presents published descriptions of both deficiency and toxicity symptoms.
- Provides coloured prints of deficiency symptoms.
- Interprets test results for both petioles and leaves for a range of cultivars.
- Charts plant nutrient data during the growing season.
- Multiple test data can be presented on the one chart.
- Single or multiple charts can be printed on one page.
- Cultivars and interpretation standards can be altered.
- Provides a comprehensive information database and bibliography for each nutrient.

CropTest can be used to assess the adequacy of a growers nutrient management program, however, there is also a need for technology which allows the development of specific nutrient management strategies for each paddock, and for such strategies to incorporate best management principles.

2. BACKGROUND

Extensive research into the nutrition and fertiliser requirements of potato crops in Australia has been funded by Industry, HRDC and State Governments. The cost of this R&D during the period 1989-1994 alone was estimated to be $3.5-4m. However, low utilisation rates (<1 to 25%) of the new information and nutrient management technology by growers and technical advisers raises the question of the value of the R&D effort to Industry. Potato nutrition R&D has focused heavily on science and technology aspects and poorly on technology transfer, education and training. For example, during 1986-1994 there have been at least 55 scientific papers and technical reports on potato nutrition published in Australia, but only 2-3 extension publications. Information packages and decision support systems which allow growers to make objective crop nutrient management decisions needed to be developed.

Industry development programs funded by HRDC have shown that growers actively adopt new information and improved crop nutrient management technology (utilisation rates increase by 20-47%) if such information packages, decision support software and training programs are provided through improved extension methods.

Major benefits of the information packages, decision support software and education programs include: (i) provide the national Industry and HRDC with tangible outcomes of the R&D effort and increased returns on the research dollar invested; (ii) improved adoption and use of the nutrient management technology by technical advisers and growers by allowing the development of better extension methods; (iii) co-ordination of the development, extension and marketing of nutrient management technology and information between States; (iv) provide growers and processors with crop management strategies to reduce cadmium residues in potatoes; (v) support for Potato Industry Development Officers currently funded by HRDC; (vi) encourage the development and adoption of sustainable production strategies which avoid resource (eg soil) degradation; (vii) facilitate the development of integrated crop management (ICM) programs and (viii) facilitate the standardisation of analytical methods, sampling procedures and interpretation strategies used in soil and plant analysis between States.

Circumstances giving rise to our research & development project to improve the nutrient management of potato crops in Australia were:

i) **Low information/technology utilisation rate.** Utilisation rates of new information and nutrient management technology by growers and technical advisers throughout Australia is only <1 to 25%.

ii) **The need for improved, directly useable nutrient management technology.** Such technology can increase the utilisation of research information significantly. Increases up to 20-47% have been reported.

iii) **The need for a reference manual(s)/electronic reference library on the nutrient management of potato crops.** Information from all sources in Australia and overseas needs to be brought together in a simple and directly useable form. At present information is scattered, often not readily accessible and not in a directly useable form.

2. BACKGROUND-*continued*

iv) **Extension publications on potato crop nutrient management need revision.** Extension publications on the nutrient management of potato crops are inadequate or are lacking. The nutrient management of potato crops has changed dramatically over the past 10-15 years (see page 36), and extension publications need to be revised or rewritten to reflect this change.

v) **The need to integrate management strategies to reduce cadmium residues in tubers into nutrient management technology.** Cadmium residues in tubers is an important issue, affecting not only the viability of individual growers, but whole growing regions.

3. OBJECTIVES

The overall aim of the project was to develop information packages and decision support software for improved nutrient management of potato (*Solanum tuberosum* L.) crops.

Specific research & development objectives were to:

i) develop decision support software to improve the nutrient management of potato crops throughout Australia;

ii) compile information on the nutrition and nutrient management of potato crops, and prepare a plant analysis and interpretation manual to facilitate adoption of this technology by technical advisers, agribusiness and growers;

iii) incorporate into the information packages management options to minimise cadmium (Cd) residues in potatoes; and

iv) provide education and guidance for technical advisers, agribusiness and growers in the use of the new nutrient management technology to facilitate its utilisation and to disseminate information.

4. *CropTest*

Potato Crop Nutrient Evaluation System

CropTest is a decision support system for improved nutrient management of potato (*Solanum tuberosum* L.) crops.

It is designed to assist agribusiness and growers identify symptoms of nutrient stress, interpret plant test data and access information on plant analysis and nutrition of potato.

See Figure 4.1. for the ***CropTest*** main screen.

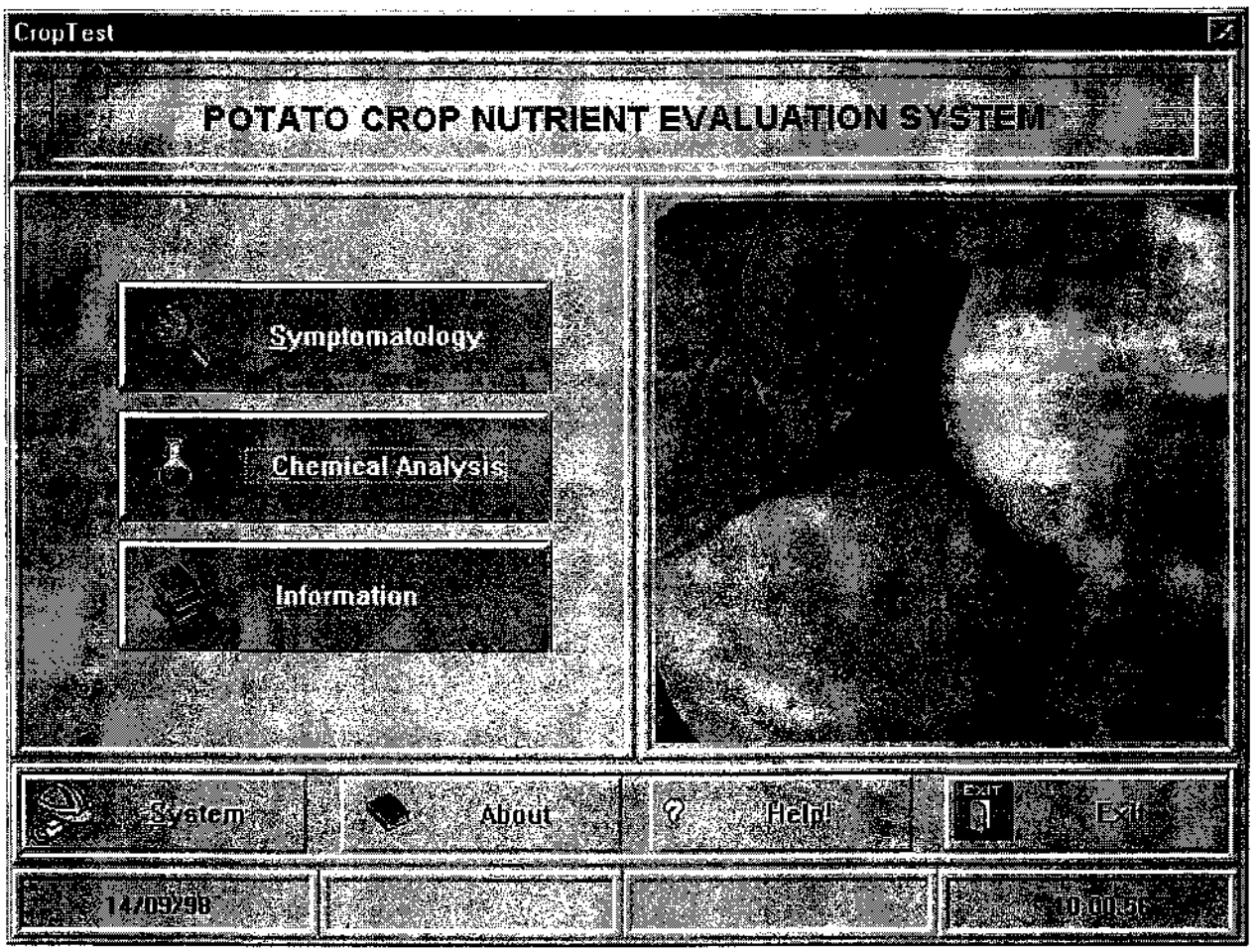
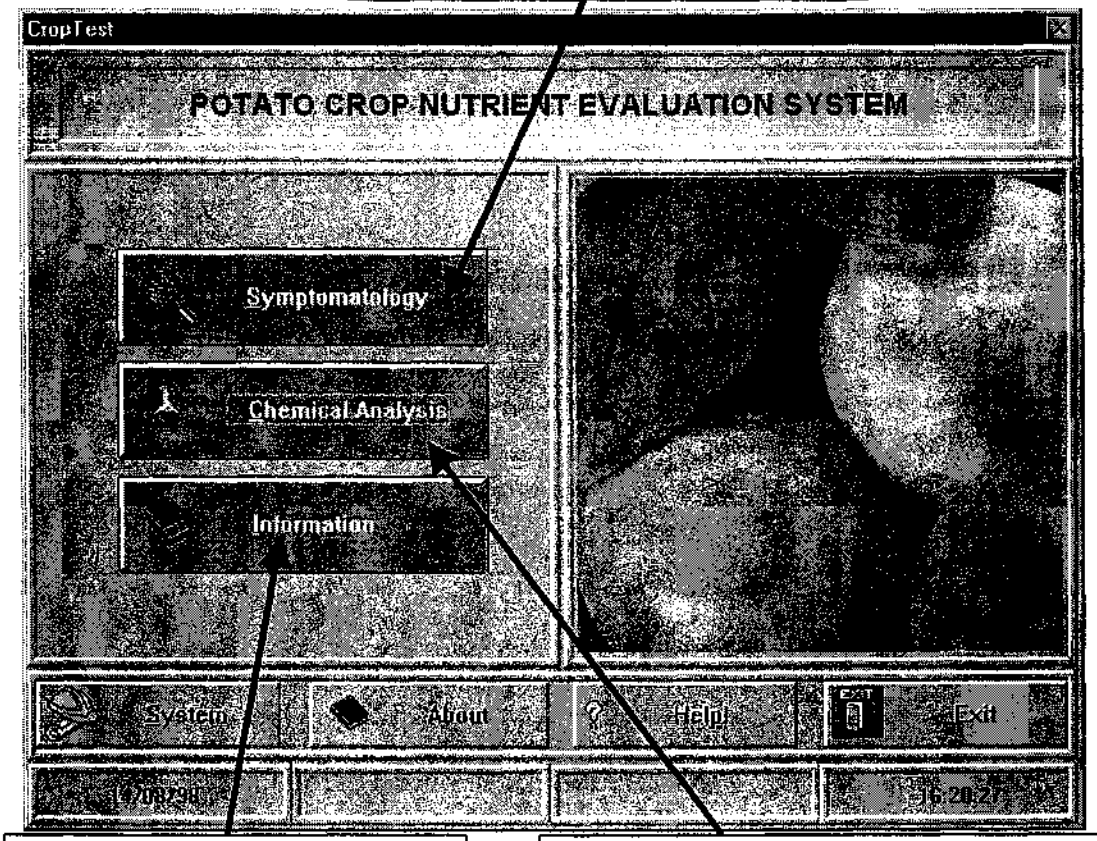


Figure 4.1. The *CropTest* main screen

Researchers and industry collaborators from around Australia contributed to the development of the software. See Section 9., page 39 for details.

4.1. FEATURES

Symptomatology module
- Provides keys to identify symptoms of nutrient stress.
- Presents published descriptions of both deficiency and toxicity symptoms.
- Provides coloured prints of deficiency symptoms.



Information module
A comprehensive reference section for information on plant analysis and nutrients, including uptake, distribution in the plant, tissue values, factors which affect nutrient levels in plants and nutrient sources.

Chemical Analysis module
- Interprets test results for both petioles and leaves for a range of cultivars.
- Charts plant nutrient data during the growing season.
- Multiple test data can be presented on the one chart.
- Single or multiple charts can be printed on one page.
- Cultivars and interpretation standards can be altered.

4.2. MINIMUM SYSTEM REQUIREMENTS

To use ***CropTest*** you need the following:

- IBM compatible computer with 486 DX2/66 processor.
- Windows 3.1™ or Windows 95™ operating system.
- Hard Disk with at least 16 Megabytes free space.
- 16 Megabytes of RAM.
- CD-ROM drive.
- Super VGA monitor with 256 colour.
- A mouse supported by Windows™.

CropTest has been designed for use on a stand alone computer, and use on a network may have unpredictable consequences.

4.3. SYMPTOMATOLOGY MODULE

The **Symptomatology** module allows you to identify nutrition related disorders based on visual symptoms exhibited by the plant. It provides keys to identify symptoms of nutrient stress, presents published descriptions of both deficiency and toxicity symptoms and provides coloured prints of deficiency symptoms (see Figure 4.3.1.).

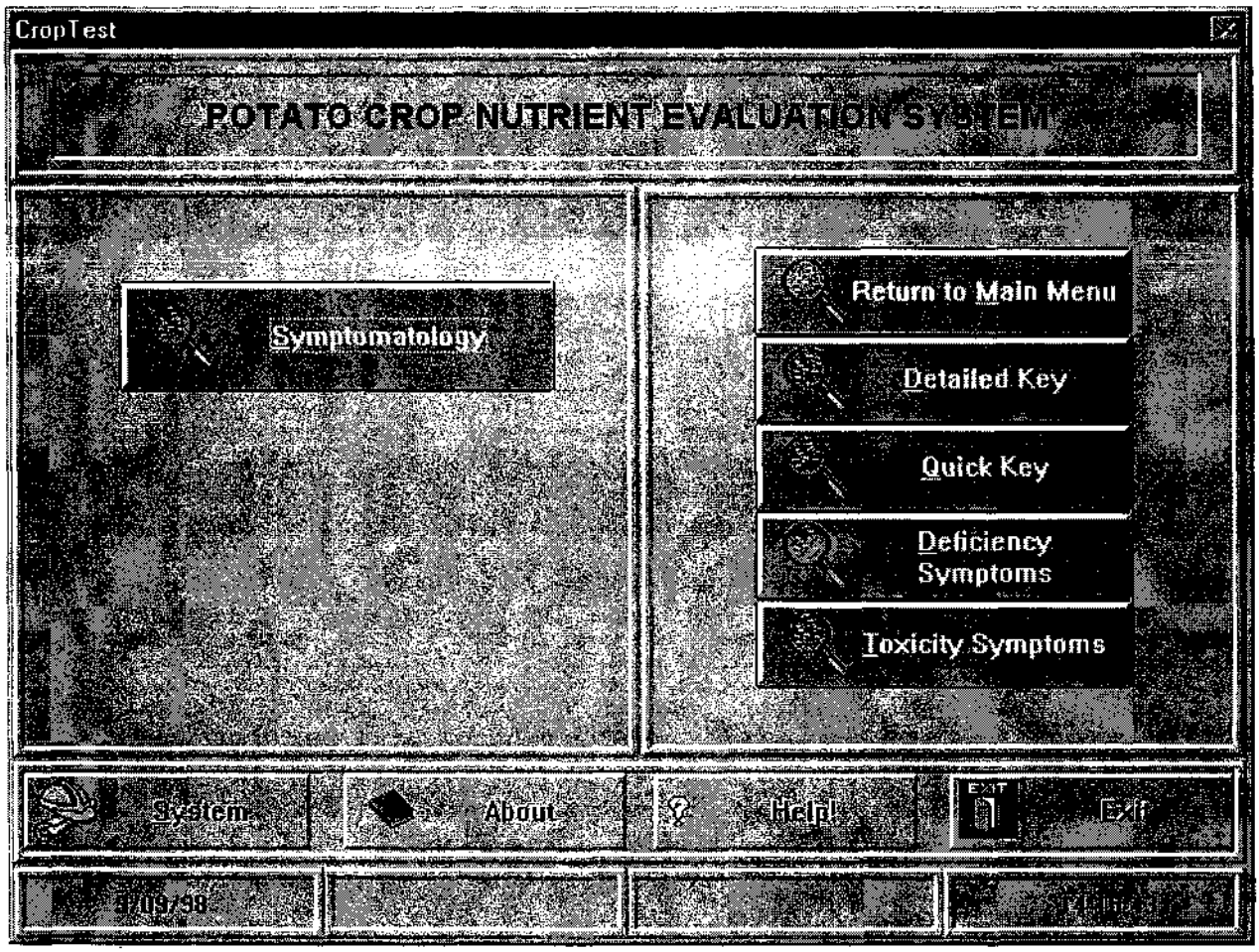


Figure 4.3.1. The Symptomatology screen

Detailed Key. Allows the user to match the symptoms on the plant with a series of photographs, to help the user identify the cause of the deficiency or toxicity.

Quick Key. Presents deficiency or toxicity symptoms in table format, based on plant part showing the symptom.

These keys should be used if the cause of the symptoms is not known.

Deficiency Symptoms. Allows the user to select a nutrient for which descriptions of deficiency symptoms are required.

4.3. SYMPTOMATOLOGY MODULE-*continued*

Toxicity Symptoms. Allows the user to select a nutrient for which descriptions of toxicity symptoms are required.

The Deficiency Symptoms or Toxicity Symptoms options should be used if the cause of the symptoms is known and it needs to be verified by comparison with published descriptions.

Detailed Key

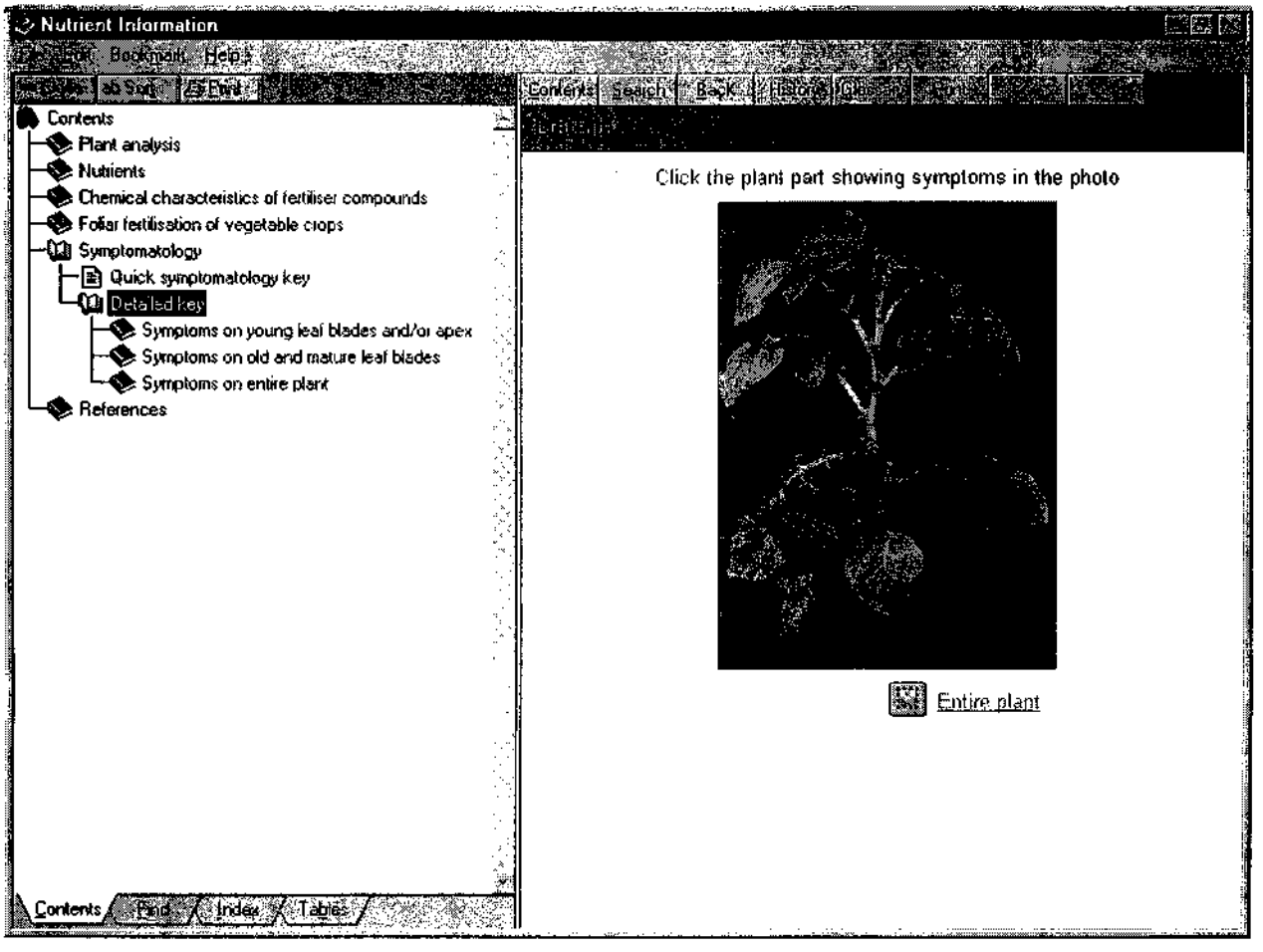


Figure 4.3.2. First screen of the Detailed Key to identify visual symptoms of nutrient stress

4.4. CHEMICAL ANALYSIS MODULE

The **Chemical Analysis** module allows the user to view, add or edit tissue test results (see Figure 4.4.1.) and interpret the results by plotting the test results as either bar or scatter (line) graphs. Scatter graphs can be used to "track" nutrient levels during the growing season, and multiple results (ie. for different paddocks or growers) can be presented on the one graph.

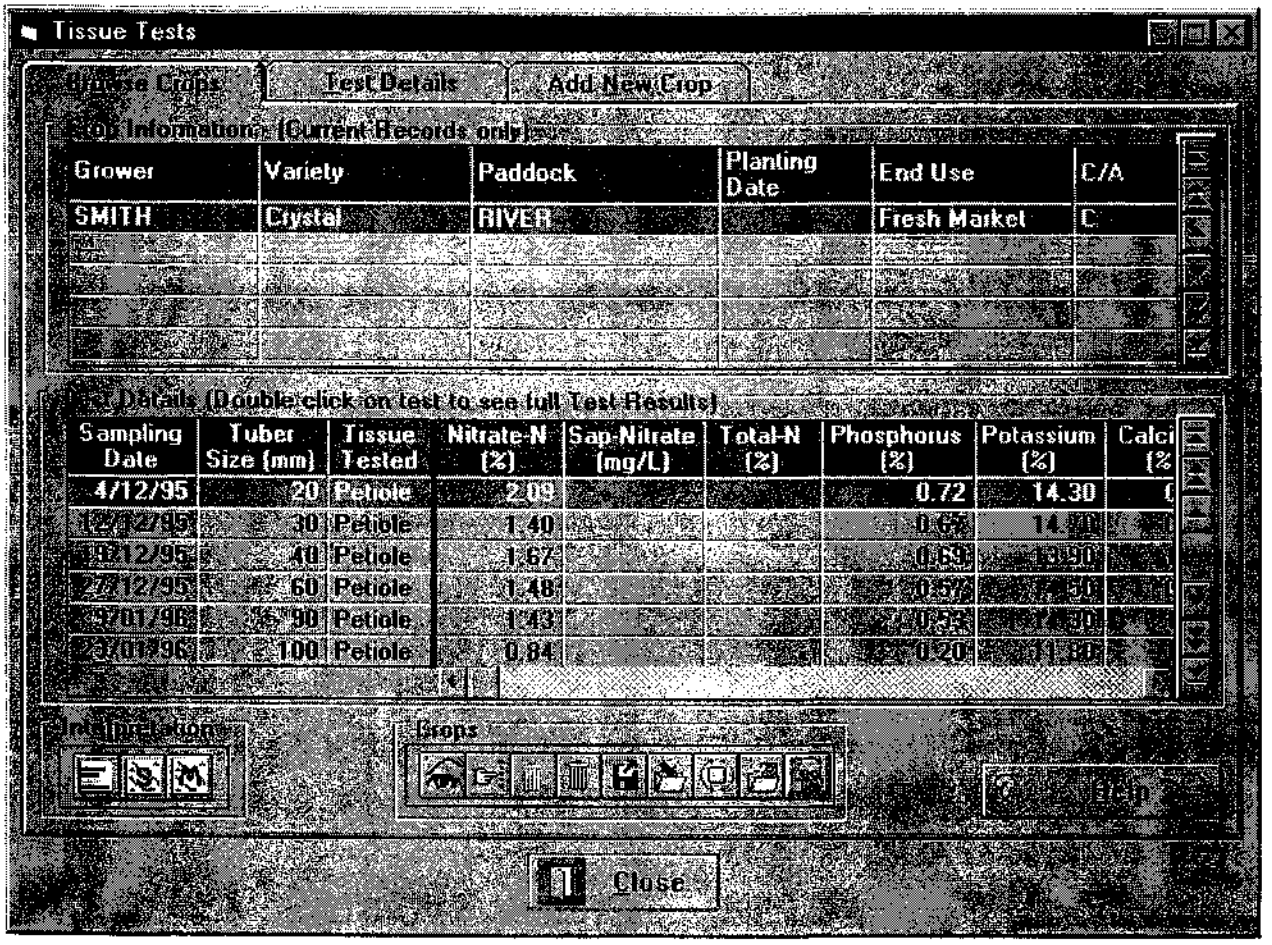


Figure 4.4.1. The Chemical Analysis screen

Before this module is used the user must carefully read the Plant Analysis section in the ***CropTest*** software *or in the Plant Analysis & Interpretation Manual for Potato.* In the Plant Analysis section, the sampling strategy to use to ensure correct interpretation of the test data, is described.

Browse Crops. This tab allows the user to view test results for a selected crop. The user can plot the results as a bar or scatter (line) graph, or select multiple crops to plot as a scatter graph for comparison purposes. This tab also contains a toolbar, which allows the user to:

- view current, archived or all crops;
- find one or more crops;

4.4. CHEMICAL ANALYSIS MODULE-*continued*

- delete test results for one or more crops;
- import test results from a diskette;
- archive or unarchive a single crop;
- archive or unarchive multiple crops, and
- export test results to a file, which you can then import into Microsoft Excel.

Test Details. This tab allows the user to view, add or edit test results, and plot the results as a bar or scatter graph.

Add New Crops. This tab allows the user to add a new crop.

Scatter or Line Graph

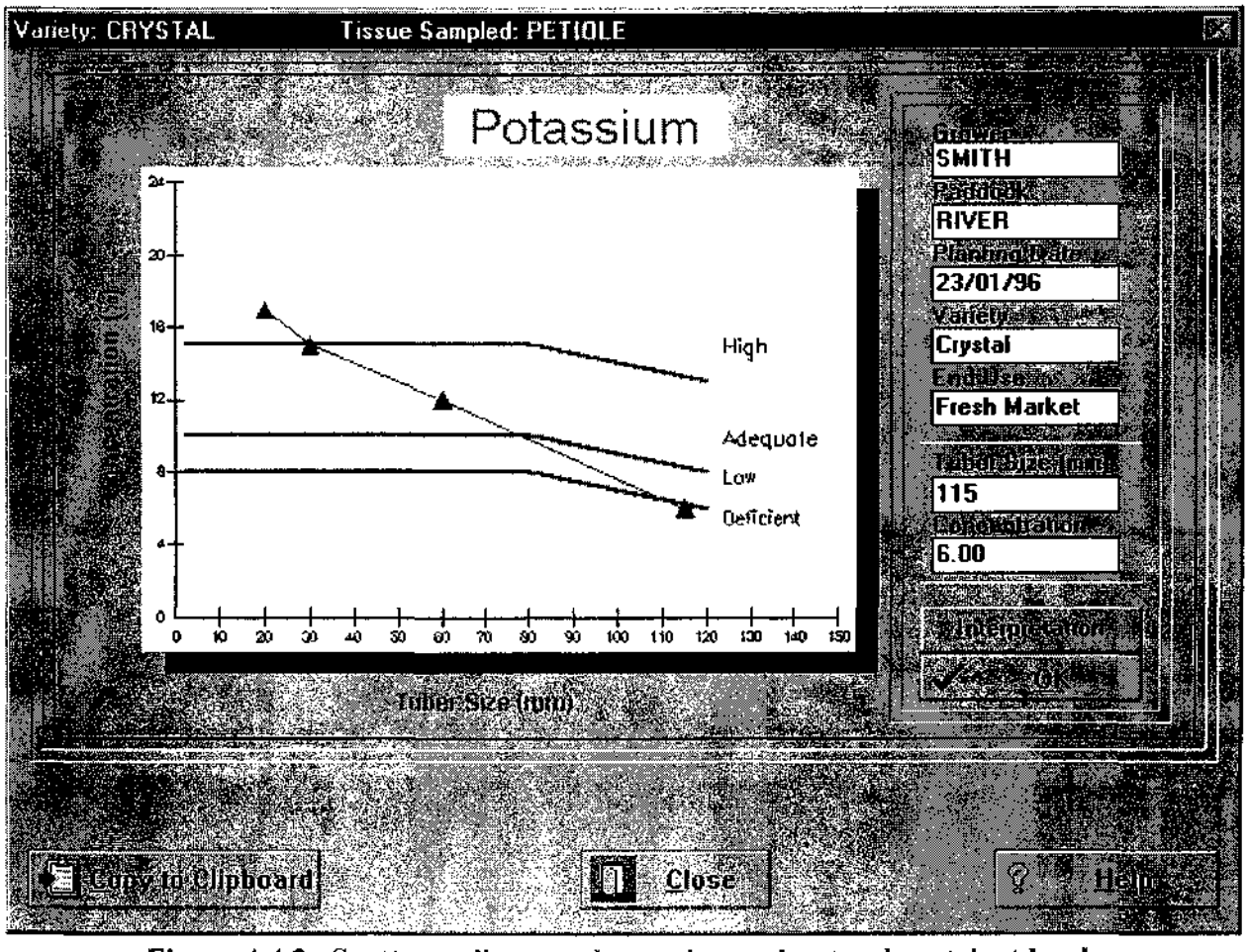


Figure 4.4.2. Scatter or line graphs can be used to track nutrient levels during the growing season

4.5. INFORMATION MODULE

The **Information** module is a comprehensive reference section for information on plant analysis and nutrients, including uptake, distribution in the plant, tissue values, factors which affect nutrient levels in plants and nutrient sources (see Figure 4.5.1.).

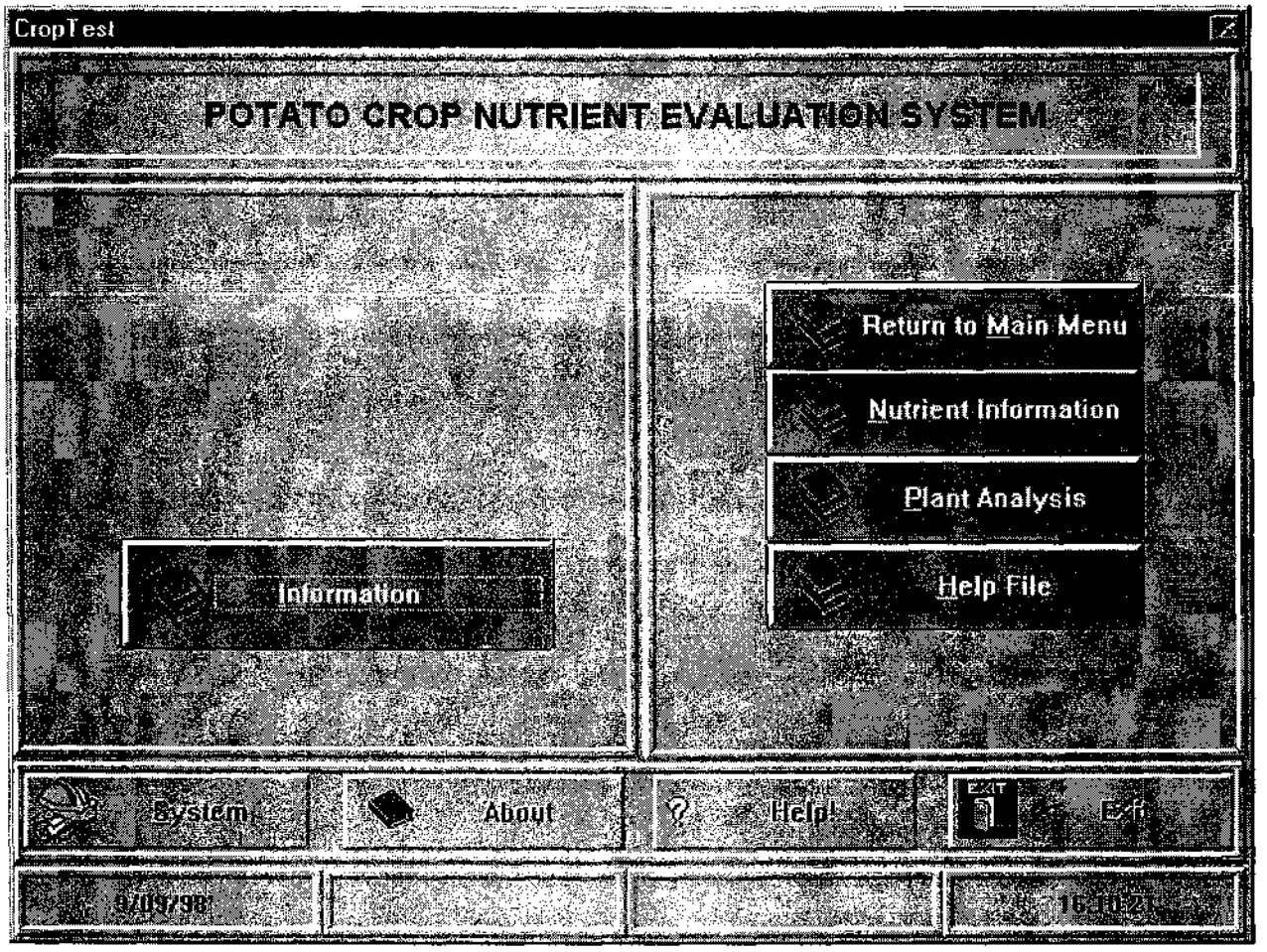


Figure 4.5.1. The Information screen

Nutrient Information. This option allows the user to view information on a selected nutrient. Information is presented for nitrogen, phosphorus, potassium, calcium, magnesium, sodium, chloride, sulfur, boron, copper, zinc, manganese and iron.

Plant Analysis. This option allows the user to view background information on many aspects of plant analysis including: the uses of plant analysis, interpretation standards, chemical analysis, sampling strategies, sample handling, development of interpretation standards, interpretation of plant test data and recommendations.

4.5. INFORMATION MODULE-*continued*

Help File. This button allows the user to launch the CropTest Help File and display the title page. The navigation tools can be used to browse through the topics.

4.5.1. Structure of the Information File

The information file is broken up into six main sections:

- Plant analysis
- Nutrients
- Chemical characteristics of fertiliser compounds
- Foliar fertilisation of vegetable crops
- Symptomatology, and
- References

4.5.1.1. Plant Analysis

This section contains background information on many aspects of plant analysis including: the uses of plant analysis, interpretation standards, chemical analysis, sampling strategies and handling, development of interpretation standards, interpretation of plant test data and recommendations.

The following graphic gives the contents list for Plant Analysis down to the fourth level:

4.5. INFORMATION MODULE-*continued*

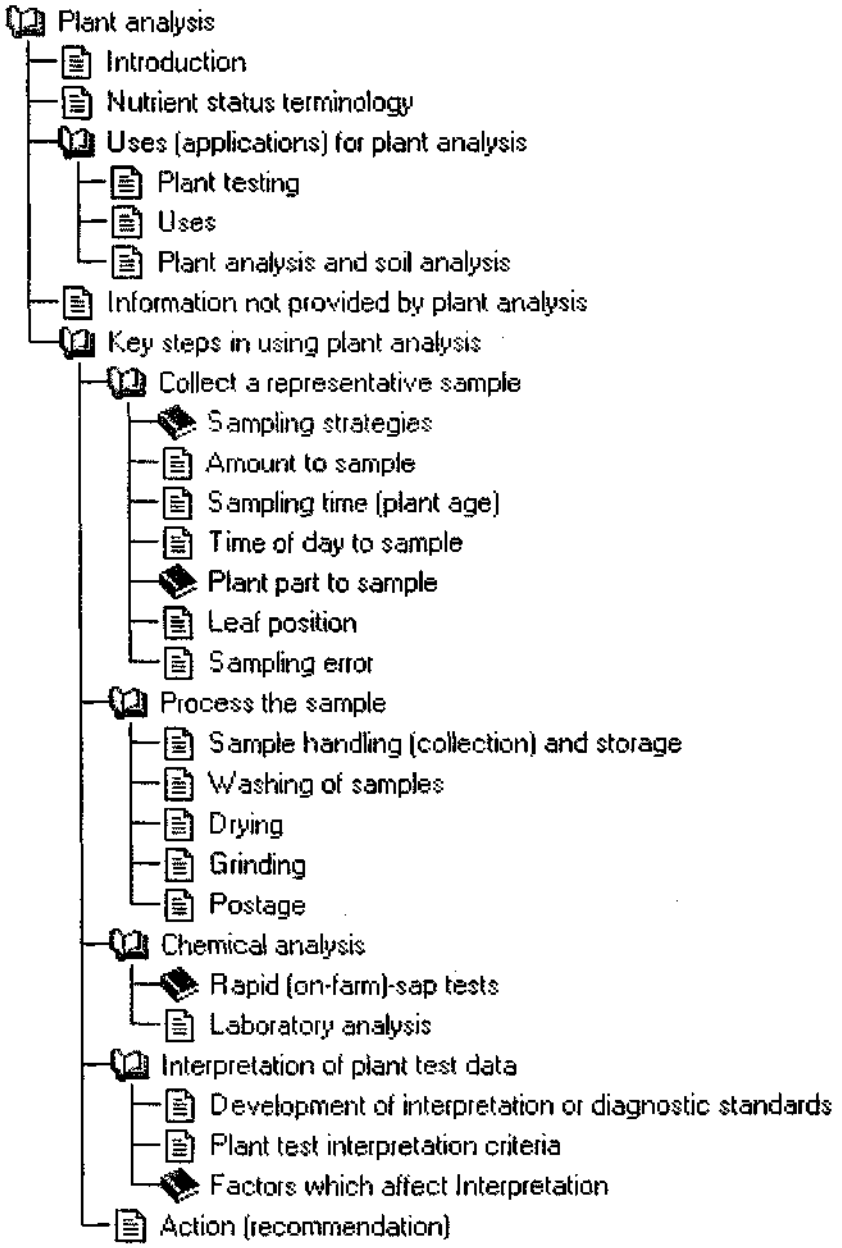


Figure 4.5.2. The contents list for Plant Analysis

4.5.1.2. Nutrients

The Nutrients section contains detailed information on the nutrients affecting plant growth. For each nutrient you will find information on:

- the function of the nutrient in the plant.
- the affect of the nutrient on plant growth, yield and quality.
- uptake and mobility of the nutrient in the plant.

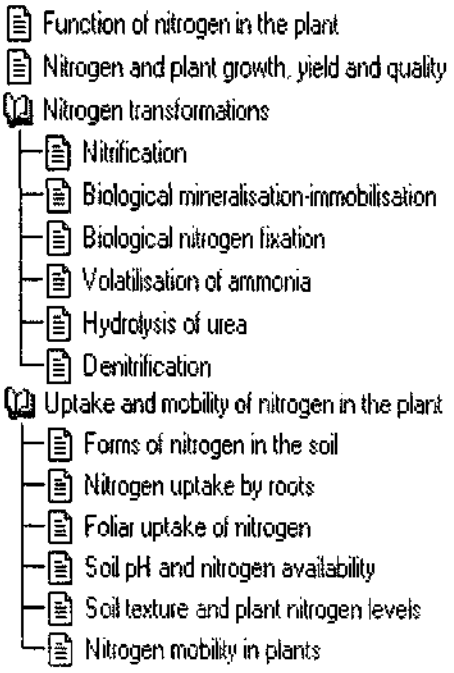
4.5. INFORMATION MODULE-*continued*

- nutrient accumulation and removal.
- visual symptoms of nutrient stress.
- disorders showing similar symptoms to nutrient stress.
- variation of nutrient concentration in the plant.
- sampling errors for the nutrient.
- interrelationships between the selected nutrient and other nutrients.
- nutrient concentrations in commercial crops.
- a bibliography of plant test data for the nutrient.
- interpretation and diagnostic standards for the nutrient.
- interpretation of plant test results for the nutrient, and
- sources of the nutrient.

Some nutrients contain additional information not covered in this list.

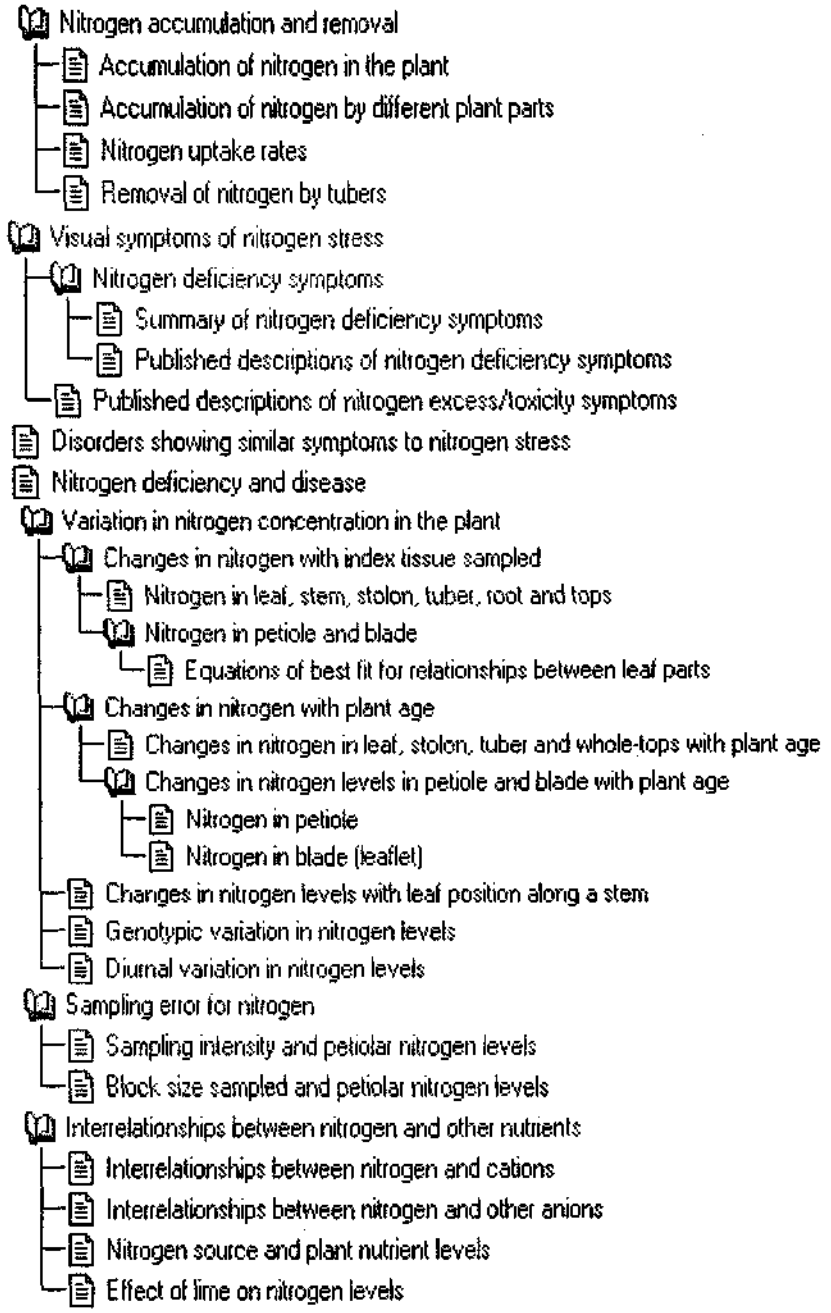
The Nutrients section also contains information on cadmium (Cd) concentrations in tubers and recommendations on what information should be recorded on your crop information sheet.

The following graphic displays the Table of Contents for Nitrogen:



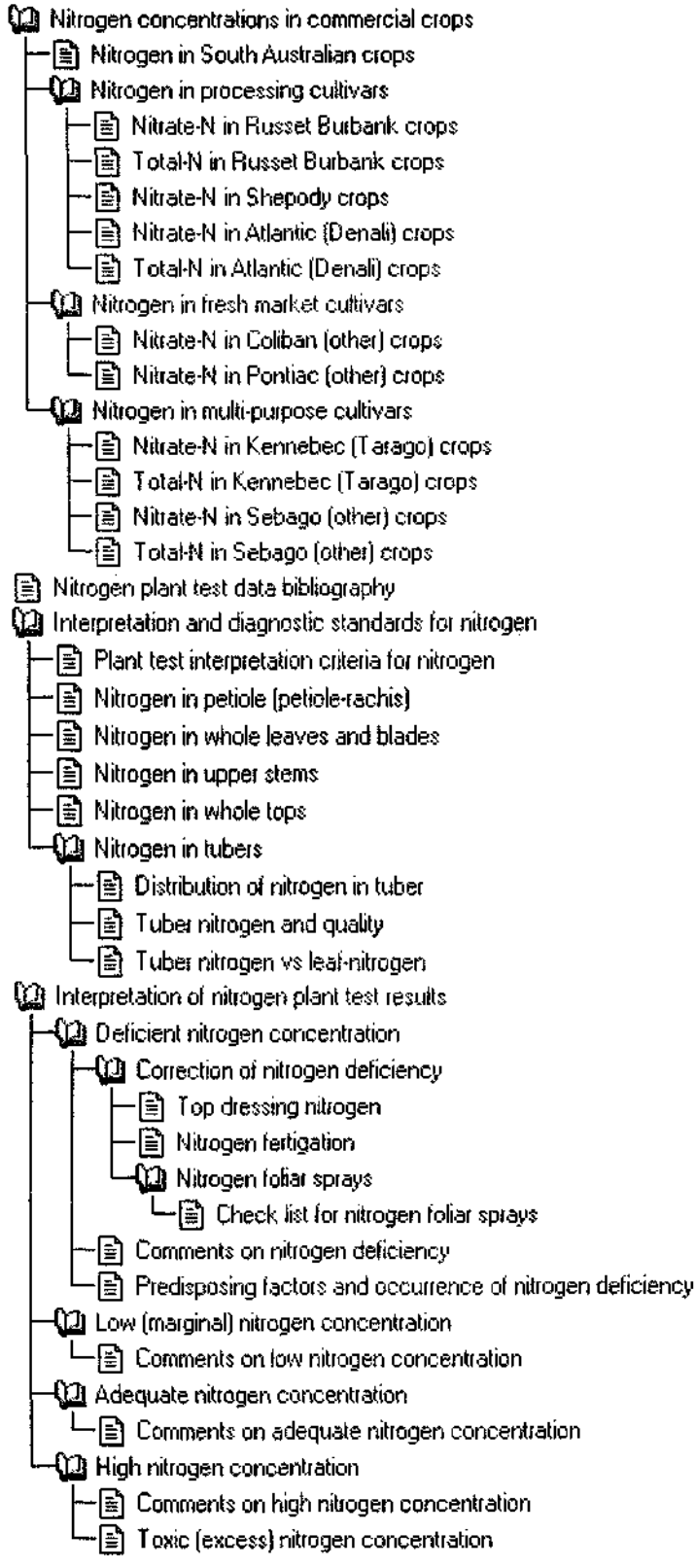
4.5. INFORMATION MODULE-*continued*

Nitrogen contents list (continued)



4.5. INFORMATION MODULE-*continued*

Nitrogen contents list (continued)



4.5. INFORMATION MODULE-*continued*

Nitrogen contents list (continued)

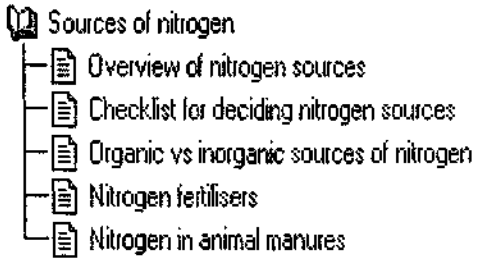


Figure 4.5.3. The contents list for Nitrogen

4.5.1.3. Chemical characteristics of fertiliser compounds

This section contains information on the chemical characteristics of primary fertiliser compounds, and includes details on:

- hygroscopicity,
- solubility in water,
- equivalent acidity or alkalinity,
- salt index, and
- compatibility of nutrients.

Information on proprietary formulations is not included.

4.5.1.4. Foliar fertilisation of vegetable crops

This section describes the fertilisation of the crop via leaves and stems.

The amounts which enter via these pathways are usually small, and are restricted to minerals derived from rain, over-head irrigation, fumes, dust and aerosols.

4.5.1.5. Symptomatology

The Symptomatology section allows you to identify nutrition related disorders from the visual symptoms exhibited by the plant.

The **Detailed Key** allows you to match the symptoms on your plant with a series of photographs, to help you identify the cause of the deficiency or toxicity of the nutrient.

The **Quick Key** presents nutrient deficiency or toxicity symptoms in a table format.

4.5. INFORMATION MODULE-*continued*

4.5.1.6. References

The References section contains a full list of references used to compile this Information File.

References are grouped by the title of the topic that contains the references. References may also be accessed by clicking *References:* at the bottom of each topic. See Figure 4.5.4. for an example.

Topic (Accumulation of nitrogen in the plant) - References

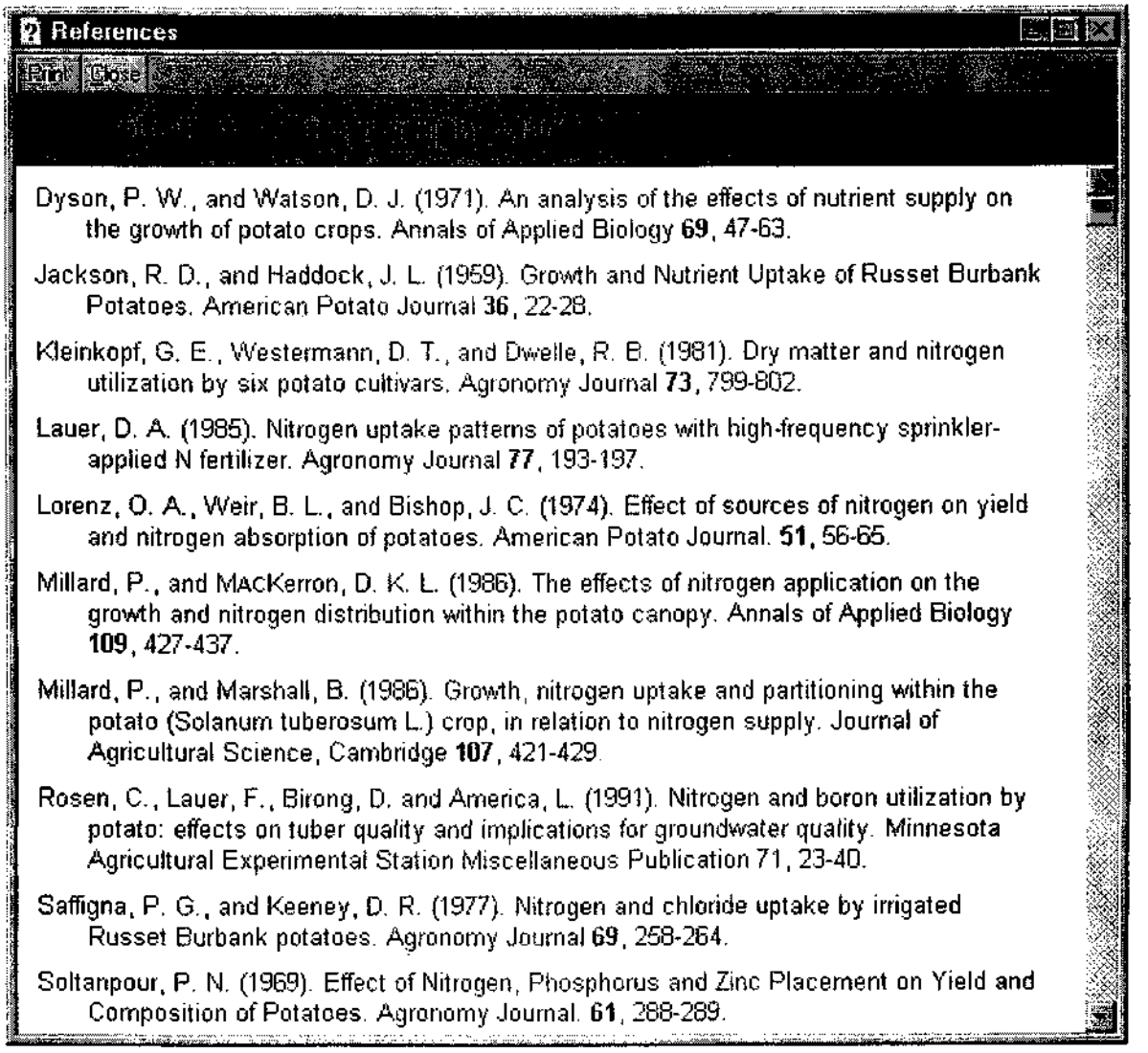


Figure 4.5.4. Reference windows allow easy access to relevant information sources

4.6. SYSTEM MODULE

The **System** screen (see Figure 4.6.1.), which is password protected, allows the user to modify system settings, for example, the interpretation standards can be altered and new varieties can be added.

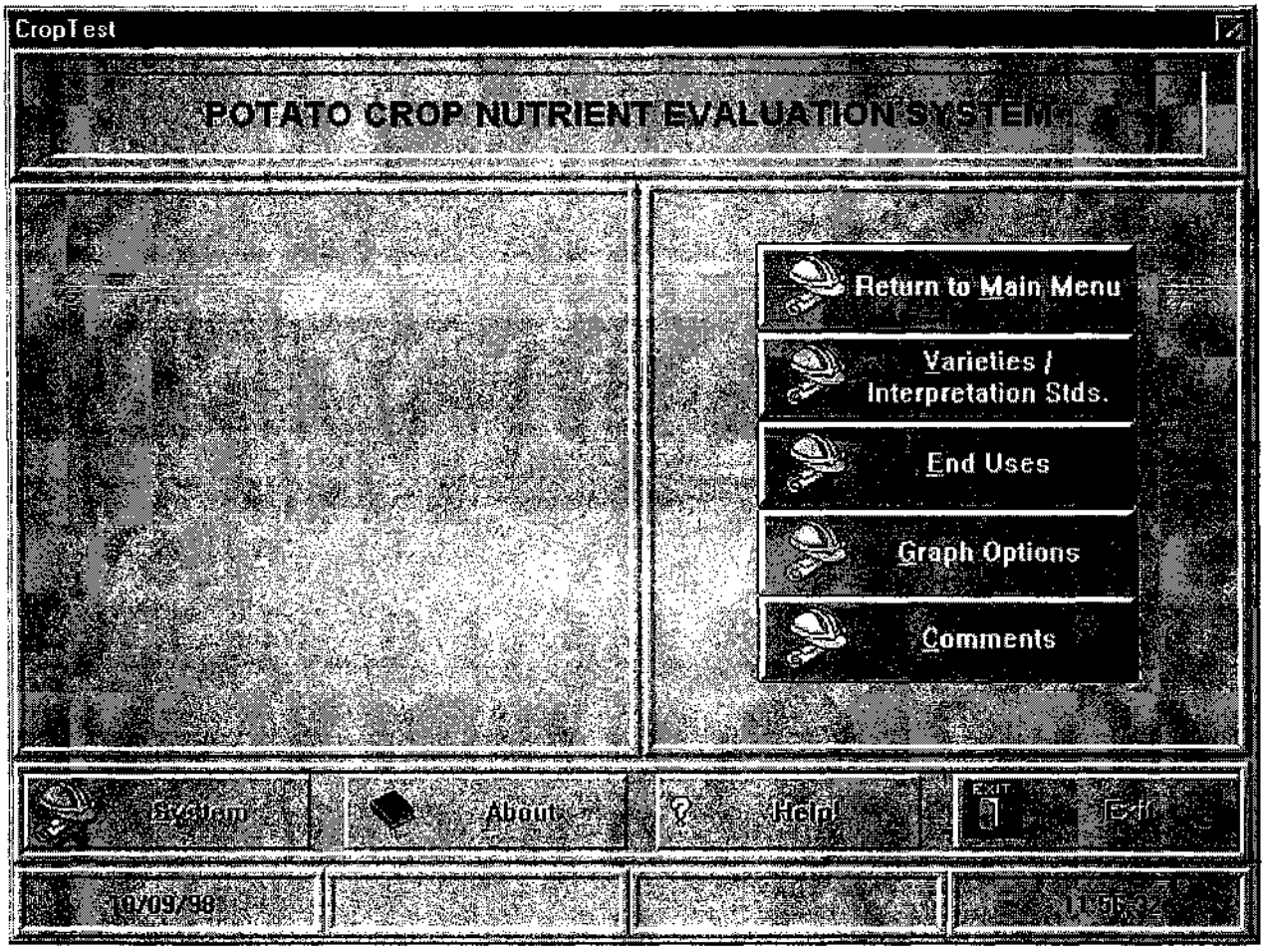


Figure 4.6.1. The System screen

Varieties/Interpretation standards. This option allows the user to edit the varieties and interpretation standards stored in the system.

End Uses. This allows the user to add or update market end use choices for potatoes.

Graph Options. This button allows the user to change graph settings, for example, bar chart colours, X- and Y-axis increments, and graph and axis titles.

Comments. This button can be used to modify comments printed with bar or scatter (line) graphs.

4.7. HELP

The ***CropTest*** software includes a Help File which is a screen based guide to the ***CropTest*** system (see Figure 4.7.1.).

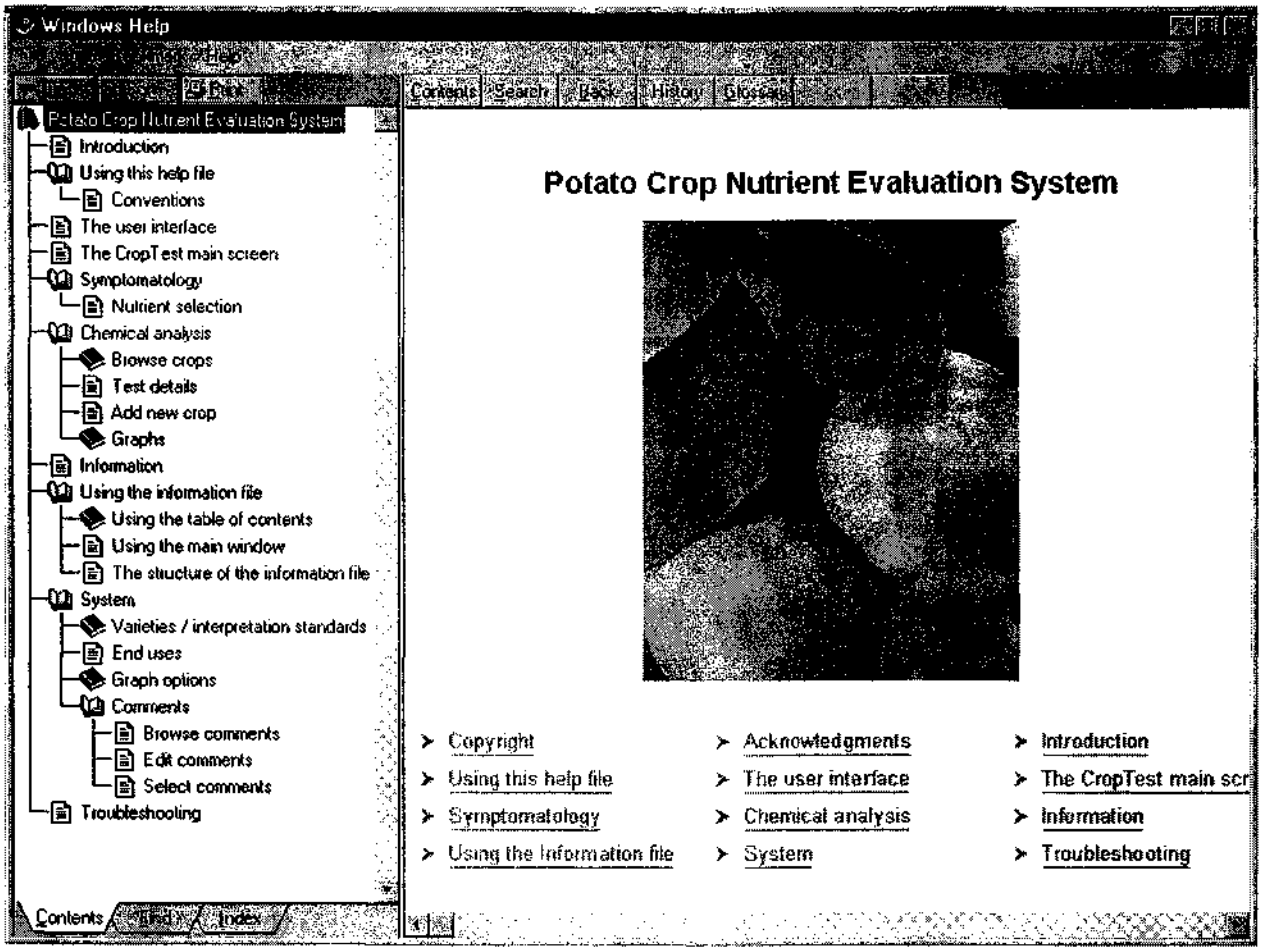


Figure 4.7.1. The Help screen

The Help system includes the following sections:

Introduction

A general introduction to the ***CropTest*** system.

The User Interface

A guide to the user interface: how to use the buttons, tools and special features that make up the ***CropTest*** system; how to move around the screens.

4.7. HELP-*continued*

The *CropTest* Main screen

Describes how to use the buttons on the main screen to access the remainder of the system.

Symptomatology

Allows the use of visual symptoms on the plant to identify the cause of the nutrient deficiency or toxicity.

Chemical Analysis

The steps involved in adding test results into the system, plotting the results on a graph and copying or printing the graph, are described.

Information

Describes how to access the large volume of reference material in the information file.

Using the Information File

Gives instructions on how to use the tools, buttons, tabs, menus, search keys and hypertext links to navigate through the information file.

System

Describes how to modify system settings, for example, interpretation standards, end uses, graph settings and comments.

Troubleshooting

Contains information and tips to help you solve problems the user may experience while using ***Croptest.***

Conventions

4.8. USER'S GUIDE

A User's Guide, ***CropTest*, Potato Crop Nutrient Evaluation System, Version No. 1, August 1998**, has been prepared for the software.

Information presented includes,

1. Introduction

2. Installing *CropTest*

Minimum System Requirements

For Windows 3.1 or 3.11

For Windows 95

3. Using This Guide

Conventions used in this Guide

4. The User Interface

The ***CropTest*** Main Screen

5. Symptomatology

Using the symptoms to identify the cause

Using symptoms to check the cause

6. Chemical Analysis

Adding a new crop

Test results

Importing test results

Viewing results

Plotting a graph

Exporting test results

Archiving tests

Deleting a crop

Deleting multiple crops

7. Using the Reference Library

Viewing nutrient information

Viewing plant analysis information

Getting help

8. Using the Information file

Using the table of contents

Using the main window

4.8. USER'S GUIDE-*continued*

4.9. SOFTWARE LICENCE AGREEMENT

A Licence Agreement indicating the terms and conditions for the use of ***CropTest*** has been developed with advice from the South Australian Crown Solicitor's Office.

A read me first document titled "IMPORTANT NOTICE" has been prepared.

It deals with the following issues:

1. Disclaimer
2. ***CropTest*** Software Licence Agreement
3. Terms and Conditions of the Agreement
    - 3.1 Issue of Licence
    - 3.2 Restrictions
    - 3.3 Proprietary Rights
    - 3.4 User Liability
    - 3.5 Preparatory reading by the user
    - 3.6 Warranty
    - 3.7 Liability of SARDI
    - 3.8 Software defects
    - 3.9 Termination

5. PLANT ANALYSIS & INTERPRETATION MANUAL for POTATO

Plant Analysis & Interpretation Manual for Potato, (1st Edition, 1998) Compiled by N. A. Maier and K. L. Shepherd, 249 pp.

This manual is part of *CropTest*, **Potato Crop Nutrient Evaluation System**, which aims to assist technical advisers and potato growers in, i) the use of plant analysis as a tool for improved nutrient management of potato crops, and ii) identifying visual symptoms of nutrient stress.

The manual consists of three sections:

5.1. Plant Analysis

Addresses the key steps of collecting a representative sample, sample handling and preparation, chemical analysis, interpretation and recommendation (action).

See section 4.5.1.1., page 15 for more detail.

5.2. Tissue Analysis Values

This section presents analysis values (concentrations) which can be used to assess the nutrient status of potato plants.

Plant testing usually involves the analysis of a specific plant part, therefore values are grouped according to the following tissues:

- Petiole (petiole-rachis).
- Whole leaf.
- Blade.
- Tops (haulms or vines).
- Tuber.

To assess the nutrient status of potato crops usually petioles or whole leaves are sampled.

The actual sampling times specified in the references are presented in the Tables (ie. Sampling time). To assist the reader we have grouped the tissue values, for each nutrient, into the following growth stages:

- Vegetative.
- Early tuber set/Tuber initiation.
- Flowering/ Early tuber bulking.
- Tuber bulking.
- Late season/Maturation.

Varieties are listed in alphabetical order in each growth stage.

All interpretation or diagnostic standards should be treated cautiously until validated for local growing conditions, cultivars and nutrient management strategies

5. PLANT ANALYSIS & INTERPRETATION MANUAL for POTATO- *continued*

5.3. Symptomatology

Information presented in this section can be used to identify visual symptoms of nutrient stress. References are presented at the end of each section. See section 4.3., page 10 for more detail

5.4. Using the manual

To use the manual effectively consider the following points:

- **How was the nutrient stress identified?**

Nutrient stress or nutritional disorders can be identified by either chemical analysis of plant tissue (plant analysis or tissue analysis) or visual symptoms (symptomatology).

Go to the **Plant Analysis** and **Tissue Analysis Values** sections if chemical analysis is to be used or test data are available, or to the **Symptomatology** section to identify visual symptoms.

5.4.1. Plant Analysis

Read the Plant Analysis section carefully, particularly if you use the Chemical Analysis module of *CropTest*

- **What is the purpose of using plant analysis?**

For comments on diagnostic testing, nutrient monitoring, predictive testing and uses of plant analysis refer to Section 3 in the **Plant Analysis** section. Note that different sampling strategies are required for different uses.

- **What are the key steps in using plant analysis?**

For information on collecting a representative sample, sample processing and handling, chemical analysis, interpretation of test results and recommendation (action), refer to Section 5 of the **Plant Analysis** section.

5.4.2. Tissue Analysis values

Note: All interpretation or diagnostic standards should be treated cautiously until validated for local growing conditions, cultivars and nutrient management strategies.

- **What plant part or tissue did you sample?**

Values (concentrations or levels) for all nutrients are grouped according to the tissue sampled. Tissues include the petiole (petiole-rachis), whole leaf, blade, tops (haulms or vines) and tubers.

Select the relevant tissue. In *CropTest* the tissue sampled is the petiole.

Note that leaf nutrient levels can also vary with the position of the leaf on the stem. This is clearly specified in the Tables (ie. Tissue, Position).

5. PLANT ANALYSIS & INTERPRETATION MANUAL for POTATO- *continued*

- **When did you sample?**

To make valid use of plant test data sampling time needs to be known.

The actual sampling times specified in the references are presented in the Tables (ie. Sampling time).

To assist the reader we have also grouped the tissue values for each nutrient into the following growth stages:

- .Vegetative
- .Early tuber set/Tuber initiation
- .Flowering/ Early tuber bulking
- .Tuber bulking
- .Late season/Maturation

In ***CropTest***, sampling time is defined by tuber size (ie. the length in millimetres of the longest tuber).

- **Which variety did you sample?**

Varieties are listed in alphabetical order in each growth stage.

5.4.3. Symptomatology

- **Keys**

Quick and detailed keys are provided to help identify symptoms of nutrient stress.

- **Descriptions of symptoms & colour plates**

This section provides detailed descriptions and photographs of symptoms.

Disorders showing similar symptoms to nutrient stress are also presented.

6. COMMERCIALISATION

As part of Project PT94028 200 kits were produced.

Each kit consists of:

CropTest decision support software (CD-ROM).

Licence Agreement, including Terms and Conditions.

User's Guide.

Plant Analysis & Interpretation Manual for Potato.

As part of the commercialisation process the following issues were dealt with:

- Packaging
- Promotion
- Sales & Distribution
- User Support
- Licence Agreement
- Pricing
- Equity sharing
- Use of commercialisation revenue
- Date of release

7. PROMOTION OF *CropTest*

7.1. Prototype versions

During the development phase prototype versions of ***CropTest*** were promoted by:

i) Demonstrations at:

Grower Meetings/Conferences

Maier, N. A., and Shepherd, K. L. (1997). *Fine tuning fertiliser management using **CropTest***. In "National Crisping Potato Workshop-Proceedings". pp. 47-54. July 21-23, Toowoomba, Queensland, Australia.

Maier, N. A. (1997). *Potato Nutrition*. Meeting of the Northern Adelaide Plains Land Management Group. Virginia Horticultural Centre, 1st December, 1997.

Technical Workshops

Maier, N. A., and Shepherd, K. L. (1997). *Horticultural Training: Pivot Agriculture*. Institute for Horticultural Development, Knoxfield, Victoria.

Nutrition decision support program – potatoes

Overview of nutrition of potatoes

***CropTest**: Potato Crop Nutrient Evaluation System Workshop*

SARDI, Plant Research Centre, Urrbrae, SA., 5-6th September, 1996.

Participants included:

N. A. Maier (SARDI, SA)

K. L. Shepherd (SARDI, SA)

Sandra Lanz (Lanz Agricultural Consulting, Bundanoon, NSW)

Tony Myers (Victorian Potato Crisping Research Group)

Pam Strange (formerly of Scholefield Robinson Horticultural Services Pty Ltd, SA)

J. Eccles (HRDC)

Jim Gunton (Kairi Research Station, Kairi, North Queensland)

Rod Lay (McCain Foods (Aust) Pty Ltd)

Jamie McMaster (Incitec Ltd)

Ken Morley (Solan Pty Ltd, Wakerie, SA)

Jim Gunton (Kairi Research Station, Kairi, North Queensland)

Murray Hegney (Western Potatoes, WA)

Ian McPharlin (Department of Agriculture, Perth, WA)

Shirley Silvia (PIRSA, Loxton, SA)

7. PROMOTION OF *CropTest-continued*

***CropTest**: Potato Crop Nutrient Evaluation System Workshop - continued*

Keith Gale (Potato Grower, Woodside, SA)

Ben Dowling (formerly PISA, Mt Gambier, SA)

Leigh Sparrow (Department of Agriculture & Fisheries, Mt Pleasant Laboratories, Kings Meadows, Tasmania)

Paul Frost (SA Fries Pty Ltd)

Paul Talay (Pivot, SA)

Activities included demonstrations of decision support systems for nutrient management of horticultural crops; demonstration and "hands on" use of prototype ***CropTest*** software; discussion of following issues: ***CropTest*** evaluation, soil analysis/fertiliser recommendations, fertiliser information, commercialisation of ***CropTest***, and review of individual chapters of the Plant Analysis & Interpretation Manual for Potato.

ii) Popular Articles

Maier, N. A., and Shepherd, K. S. (1995). *Improved nutrient management of potatoes*. Good Fruit & Vegetables 6(2), p. 12.

Maier, N. A., and Shepherd, K. S. (1997). *Accessible information turns nutrient management of potato crops around.* HRDC Research Report 1996/97. Vegetables & Other Crops, p.17.

Maier, N. A., and Shepherd, K. S. (1998). ***CropTest** Potato Crop Nutrient Evaluation system*. Spud Speak No.10, p.4.

7.2. Promotion of *CropTest* kits

CropTest can be promoted by:

i) Distribution of a single page publicity leaflet. A total of 2000 have been produced. It indicates the key features of the software, minimum system requirements, support, contact for more information and proprietary information.

ii) Demonstrations/Advertising:

a) In Industry publications, for example, Spud Speak, Potato Australia and Eyes and Potatoes. The publicity leaflet can be distributed in these publications.

b) Via the Internet, electronic e-mail groups.

c) At grower meetings, field days and conferences.

iii) Direct contact with growers, scientific colleagues and agribusiness.

8. DIRECTIONS FOR FUTURE RESEARCH & DEVELOPMENT

The major focus of the nutrition research & development (R & D) program should be to develop improved crop nutrient management technologies (products, practices and services), which are not only consistent with best management practices (BMPs), but also reduce the cost to growers of nutrient management and increase the efficiency and sustainability of fertiliser use.

8.1. Potato nutrition research in Australia

Over the past 10-15 years many Australian studies have been published into the effects of nitrogen (Table 8.1.), phosphorus (Table 8.2.), potassium (Table 8.3.) and trace elements (Table 8.4.) potato growth, yield and quality.

Table 8.1. Nitrogen studies

CULTIVAR	STATE	TUBER ATTRIBUTES STUDIED	REFERENCES
Kennebec Coliban Atlantic	SA	Yield, Size, Crisp Colour, Reducing sugar concentration, Specific gravity (SG)	Dahlenburg (1982) Williams (1985) Dahlenburg *et al.* (1989) Dahlenburg *et al.* (1990) Williams and Maier (1990a) Maier *et al.* (1994)
Russet Burbank Cadima	WA	Yield, Size, SG, Crisp Colour, Hollow Heart, Internal Browning, Shape	McKay and d'Adhemar (1996)
N,P,K Interaction Studies	SA	Yield, Size, SG, Crisp Colour, After-cooking Darkening (ACD)	Dahlenburg and Maier (1989) Maier *et al.*(1994)
Sebago	Qld	Yield, SG	Laurence *et al.* (1985)

8. DIRECTIONS FOR FUTURE RESEARCH & DEVELOPMENT-*continued*

Table 8.2. Phosphorus studies

CULTIVAR	STATE	TUBER ATTRIBUTES STUDIED	REFERENCES
Atlantic Kennebec Coliban	SA	Yield, Size, SG, Crisp Colour, After-cooking Darkening	Maier *et al.* (1989a, 1989b, 1989c, 1994)
Kennebec Kennebec Russet Burbank	Vic Vic	Yield, Size, Number Yield, Size, Number, Fry Colour, SG	Strange and Marshal (1990) Freeman *et al.* (1996)
Delaware	WA	Yield	Hegney *et al.* (1997)
Russet Burbank	Tas	Yield, Cadmium (Cd), SG, Shape, Secondary Growth	Sparrow *et al.* (1992)
N,P,K Interaction Studies	SA	Yield, Size, SG, Crisp Colour, After-cooking Darkening	Dahlenburg and Maier (1989) Maier *et al.* (1994)

Table 8.3. Potassium studies

CULTIVAR	STATE	TUBER ATTRIBUTES STUDIED	REFERENCES
Kennebec Atlantic Coliban	SA	Yield, Size, SG, Internal Bruising, Source of K, ACD	Maier 1986 Maier *et al.* 1986 Maier *et al.* (1994)
Kennebec Russet Burbank	Tas	Yield, Size, Number, SG, Bruising, Crisp Colour	Chapman *et al.* (1992)
Kennebec	WA	Yield, Size, SG, Number	McKay and d'Adhemar (1996)
N,P,K Interaction Studies	SA	Yield, Size, SG, Crisp Colour, After-cooking Darkening	Dahlenburg and Maier (1989) Maier *et al.* (1994)

Table 8.4. Trace elements

NUTRIENT	STATE	CULTIVAR	TUBER ATTRIBUTES STUDIED	REFERENCES
Cu	SA		Yield, SG, Crisp Colour	D.C. Lewis (pers. comm.)
Cu, Zn, B, Mo	Tas	RB	Yield, Size, SG, Bruising Index, Crisp Colour, Scab	Sparrow *et al.* (1995)
B	Qld	Sebago	Height, Yield, Size, SG, Stem Number, Brown Fleck, Vascular Discoloration	Pregno and Armour (1992)

8. DIRECTIONS FOR FUTURE RESEARCH & DEVELOPMENT-*continued*

Studies have also been conducted into the effect of nutrient management on cadmium (Cd) residues in tubers.

Table 8.5. Cadmium studies

STATE	VARIABLES STUDIED	REFERENCES
Qld NSW Vic Tas WA	Liming Zinc Potassium source Cultivar Nitrogen source Phosphorus Salinity	Sparrow *et al.* (1992, 1993) McLaughlin *et al.* (1994a, b; 1997) Maier *et al.* (1995; 1997)

8.2. Changes in crop nutrient management practices

The studies cited in Tables 8.1. - 8.5. have generated knowledge on the effect of nutrition on tuber yield and quality, and have been responsible for the introduction of improved practices in the way the nutrient requirements and nutrient status of crops can be managed (See Table 8.6.).

Table 8.6. Changes in crop nutrient management practices and technology used in the potato industry

PERIOD	PRACTICES AND TECHNOLOGY USED
Before 1985	•There was no locally calibrated technology available to allow objective fertiliser recommendations or assessment of crop nutrient status. •Regional fertiliser recommendations were used. •Individual crops may have been under- or over-fertilised.
1985-94	•Many studies were conducted which introduced new technology to objectively determine nutrient requirements (soil testing), and assess crop nutrient status (plant analysis). See Tables 8.1. to 8.5. •Interpretation standards published were widely adopted throughout Australia. •Publication of a Tech Note, describing plant analysis procedures and interpretation standards in 1987, was the first such publication for potatoes in Australia. •Development of best management practices (BMPs) for nutrient management.
Since 1995	•Integration of all aspects of crop nutrient management by developing decision support software. •Development of ***CropTest***. •*Directly useable technologies* such as ***CropTest***, represent the next generation in crop nutrient management options for use by the Industry.

8. DIRECTIONS FOR FUTURE RESEARCH & DEVELOPMENT-*continued*

8.3. Directly useable technologies

An important issue in relation to the nutrient management of potato crops is the delivery of research findings (knowledge) to growers and agribusiness.

One strategy to increase the utilisation of improved nutrient management technology/practices is to develop **directly useable technologies** (*products, practices and services*) for use by agribusiness and growers. See Figure 8.1., page 38.

Directly useable technologies should assist growers, or their technical advisers, to make nutrient management decisions which affect their crop(s).

The development of directly useable technologies from both Australian and overseas information on potato nutrition is lacking, even though such technologies are an effective means of information/technology transfer to growers and service providers.

Further directly useable technologies should be developed for the potato industry in relation to:

- nutrient budgeting or nutrient management plans for paddocks (and farms?)
- determining crop nutrient, including fertiliser, requirements
- best management practices (BMPs) to optimise productivity and quality
- nutrient management and the environment

A research & development proposal to address these issues is being developed for submission to HRDC in 1999.

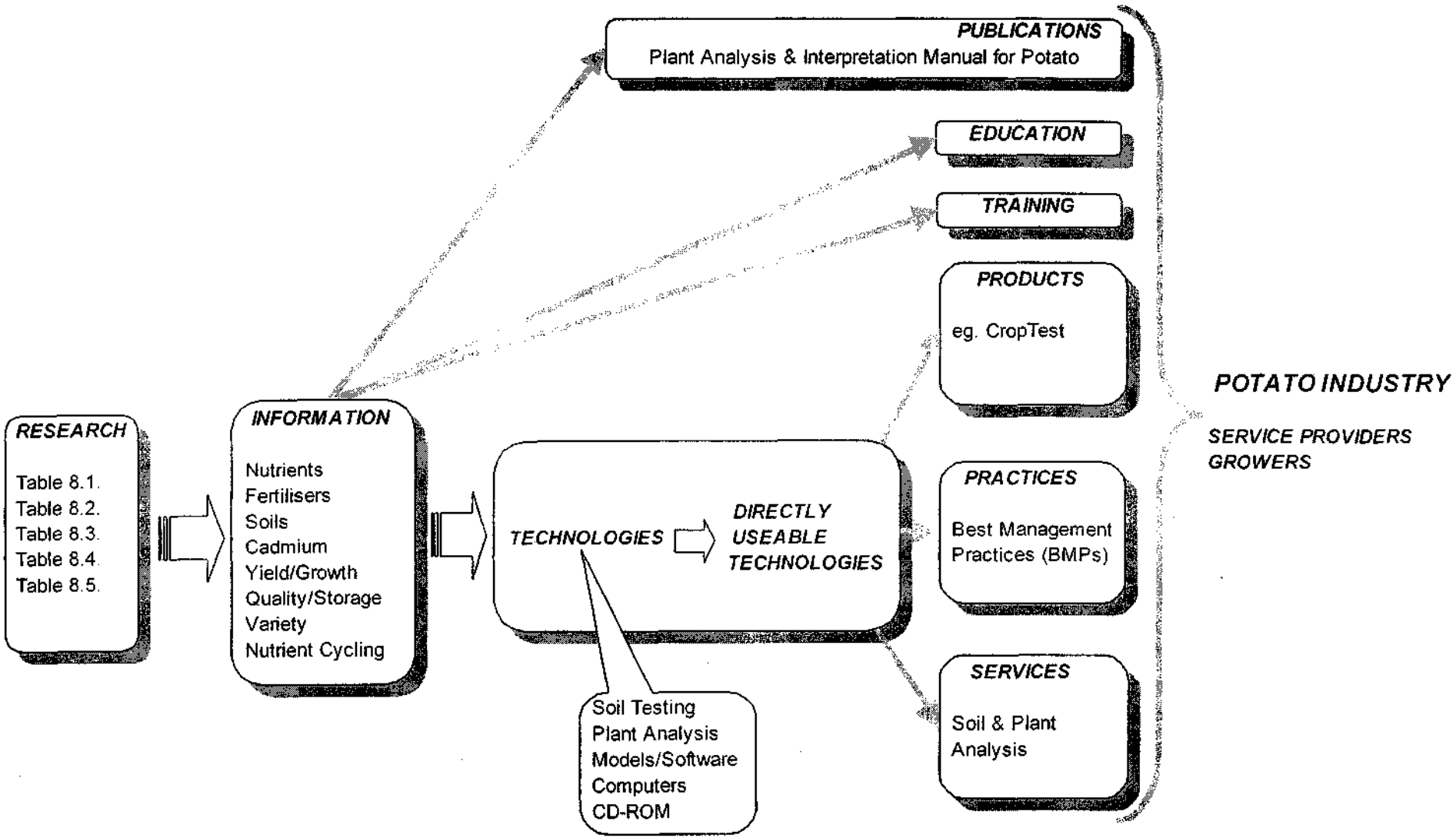


Figure 8.1. Delivering improved nutrient management technology to the potato industry

9. COLLABORATORS/ACKNOWLEDGMENTS

CropTest (Potato Crop Nutrient Evaluation System) was an initiative of the South Australian Research & Development Institute (SARDI).

It was funded and supported by the following organisations:

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

HRDC

CropTest **was made possible with the assistance and support of the following people:**

For providing plant analysis and crop information data:

Mark Heap/Paul Frost (formerly of Potato Crop Management Services, PI(SA), SA)

Rod Lay/David Ryan (McCain Foods (Aust) Pty Ltd, Vic)

Sandra Lanz (Lanz Agricultural Consulting, Bundanoon, NSW)

Tony Myers (Victorian Potato Crisping Research Group)

Pam Strange (formerly of Scholefield Robinson Horticultural Services Pty Ltd, SA)

Trevor Twigden (Horticare Pty Ltd, Murray Bridge, SA)

Neil Delroy (Horticultural Management Pty Ltd, Manjimup, WA)

Keith Gale (Potato Grower, Woodside, SA)

Ken Morley (Solan Pty Ltd, Wakerie, SA)

Jim Gunton (Kairi Research Station, Kairi, North Queensland)

Karen Freeman (formerly of National Potato Improvement Centre, Toolangi, Victoria)

Rene de Jong (Agriculture Victoria)

Leigh Sparrow (Department of Agriculture & Fisheries, Mt Pleasant Laboratories, Kings Meadows, Tasmania)

Ron Wenzel (Potato Grower, SA)

Chris Williams (Senior Research Scientist, SARDI)

9. COLLABORATORS/ACKNOWLEDGMENTS-*continued*

For reviewing chapters in the Information module:

Rod Lay (McCain Foods (Aust) Pty Ltd)

Jamie McMaster, Graham Price and Garry Kuhn (Incitec Ltd)

Ken Morley (Solan Pty Ltd, Wakerie, SA)

Jim Gunton (Kairi Research Station, Kairi, North Queensland)

Murray Hegney (Western Potatoes, WA)

Ian McPharlin (Department of Agriculture, Perth, WA)

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Keith Gale (Potato Grower, Woodside, SA)

Ben Dowling (formerly PIRSA, Mt Gambier, SA)

Leigh Sparrow (Department of Agriculture & Fisheries, Mt Pleasant Laboratories, Kings Meadows, Tasmania)

Paul Frost (SA Fries Pty Ltd)

10. VEGTEC 20000 – 1996 NATIONAL VEGETABLE & POTATO INDUSTRY CONFERENCE POSTER

CropTest POSTER

The Conference was held 7-9th July, 1996, and the theme was *adopting new technology to improve productivity and profitability.*

A poster describing the key features of a prototype version of ***CropTest*** was exhibited at the conference.

POTATO CROP NUTRIENT EVALUATION SYSTEM

N A Maier and K L Shepherd
Horticultural Nutrition, SARDI, Plant Research Centre, Urrbrae SA

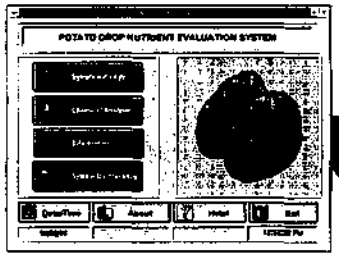
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

HRDC

WHAT IS IT?

User friendly, Windows™ based Decision Support Software System for the evaluation of the nutrient status of potato crops

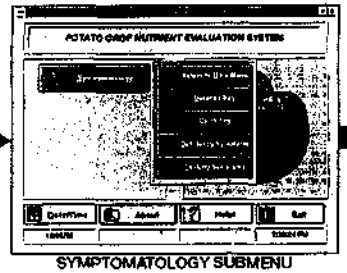
Reference library for all aspects of plant analysis in potatoes



MAIN MENU

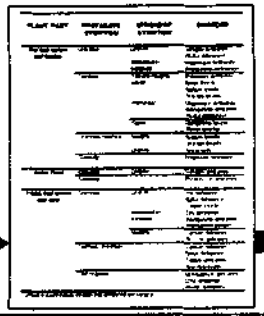
DIAGNOSIS OF NUTRIENT STATUS

VISUAL SYMPTOMS OPTION



SYMPTOMATOLOGY SUBMENU

QUICK KEY OPTION



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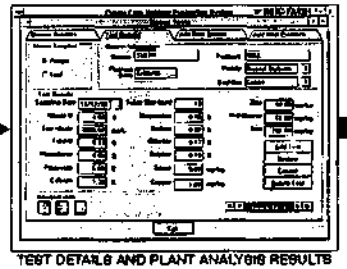
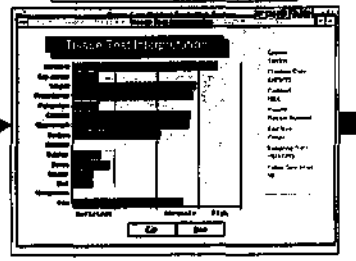


TEST DETAILS AND PLANT ANALYSIS RESULTS

INTERPRETATION

BAR CHART OPTION



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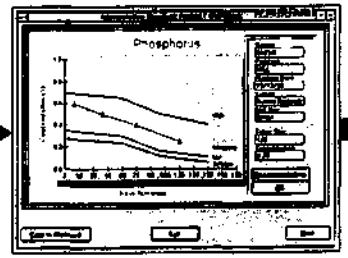
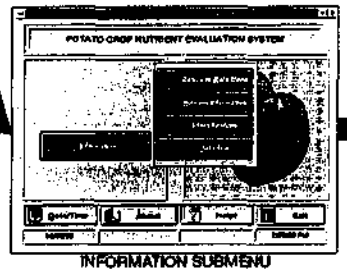


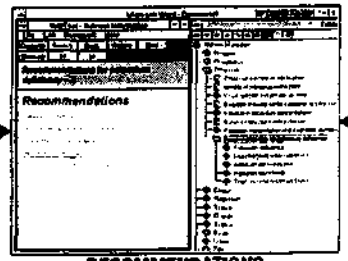
REFERENCE LIBRARY

SYSTEM MAINTENANCE

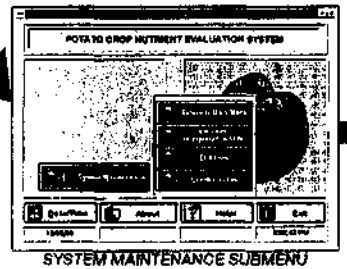


INFORMATION SUBMENU

NUTRIENT INFORMATION OPTION

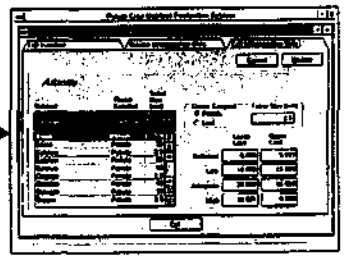


RECOMMENDATIONS



SYSTEM MAINTENANCE SUBMENU

INTERPRETATION STANDARDS OR VARIETY OPTIONS



USERS

Specialist Advisers, Consultants, Industry Development Officers and Growers

SARDI

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